

INVESTIGATION OF ENGINE INTERNAL COMBUSTION

TO REDUCE EXHAUST EMISSION: A REVIEW

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ABSTRACT

Biofuels are derived from vegetable oil or animal fat or non-edible oils such as Jatropha methyl ester (JME), Coconut (CME), Soybean Methyl Ester (SME) by chemical or physical process, and palm Ester (PME). However, the supply of these biofuels is limited and emissions of NO_x , CO, HC, Soot, PM, etc., which burn these fuels have a negative impact on the environment. Reducing exhaust emissions, the exhaust gas recirculation (EGR) is used that can make the exhaust gas into engine chamber again, then make the fuel air ratio thin when the combustion timing can be used to generate eddy currents in air and fuel mixing due to changes in the engine ignition delay or the shape of the piston used. In recent years, environmental and air pollution are mainly problems due to emissions of diesel engines and other vehicles, which may be related to different health effects. In the past few years, the vehicles have caused serious air pollution due to exhaust emissions, so we can solve the effort to find biofuels to reduce air pollution. In this paper, the main problem is that how to solve the carbide, PM, soot, nitride emissions. Therefore, this paper analyzes and compares the emissions and health effects of various biofuels, and the methods minimize the emissions of fuels that can be found during the combustion process.

KEYWORDS: *Combustion, Biofuels, Exhaust Emissions, Biodiesel Fuels, Air-Fuel Ratio & Diesel Engine*

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1. INTRODUCTION

In this century, energy plays an important role in the development of world economy and culture. Non-renewable fuels such as coal, oil and natural gas play an important role in the world's energy use. Nowadays, countries such as China due to the current economic growth and progress, countries that have imported fossils from other countries have been consuming rapidly, and we are concerned about the energy exhausted that, we have to find suitable alternative fuels for the car engine.

Due to the characteristics and composition of diesel, exhaust emissions can cause severe air pollutions and are associated with different health effects. Thus, in this study, we study and analyze the various fuels other than diesel and gasoline, such as bio-oil plants, rubbish, people eat, the remaining food residues, microbial oil, animal and human excreta[17]. These wastes can be converted into fuels, for that we can use various chemical and physical reactions.

During the combustion of the engine, these fuels replace diesel fuel for analysis. For example, oxidized fuels play an important role in reducing diesel emissions, particularly diesel dust and PM (particulate matter) emissions [5][7]. But, oxidized fuel cannot reduce NO_x emissions. Because, the NO will be oxidized during the

combustion in chamber when the temperature high. For that, we set the EGR system let the exhaust gas into combustion chamber for reducing NO_x emission. Biodiesel can be produced by transesterification of bio-oils, vegetable oils and waste fats from fish and animals are the current source.

In this paper, the authors report a significant reduction in CO, HC, particulate matter and nitrogen oxide emissions under engine loading compared to diesel. The report shows us engine emissions, including particulate matter, carbon monoxide, carbon dioxide and nitrogen oxide emissions. However, when the engine experiments made under different loads, generated the exhaust emissions got at different levels. Anyhow, this article will show that biodiesel investigates engine performance and emissions compared with diesel. [5].

Carbon dioxide (CO_2) is a greenhouse gas from automotive exhaust gas from IC engines, thus increasing fuel economy and reducing greenhouse gases using higher hydrogen to carbon fuels, or using renewable fuels to reduce carbon emissions from IC engines. We can improve the fuel economy by changing the mixture, use additional hydrogen gas. As shown above, we can convert higher hydrogen to a carbon ratio during the combustion process. So, we can use natural gas as the engine fuel. It can change the H / C ratio from 1.8 to 3.7 or higher[40]. And, the natural gases have wide flammability limit, due to air-fuel ratio reduce the knockout trend of natural gas engines, so we can improve the pressure level. Because natural gas has to use high compression ratio for reserving, then causes the high storage costs. The high compression ratio can cause the combustion reduce pollution emission and improve the thermal efficiency. Under lean conditions, natural gas engines can achieve levels below carbon dioxide, maintaining almost the same thermal efficiency as diesel engines. Under such conditions, natural gas engines can reduce carbon dioxide emissions by more than 20% compared to diesel engines with the same power and torque conditions.

In the future, the world's air traffic will continue to grow, making the air transport sector one of the fastest growing transport sectors. Because of the impact of biofuels on carbon dioxide (CO_2) emissions, there is no doubt that biofuels need to be evaluated in view of the full lifecycle of the fuel[11].

In addition, particulate matter and nitrogen oxide emissions and HC emissions will have a serious health and environmental impact, when there is sufficiently high concentration that causes human respiratory disease. For example, natural gas engines produce lower PM than diesel engines, because of the internal characteristics of natural gas, which do not contain aromatic compounds, such as petroleum fuels, less than benzene and dissolved impurities. Natural gas low flame and low temperature combustion can reduce NO_x emissions at high compression ratios. Due to the lean equivalent ratio, NO_x and CO emissions can be reduced. And, the engine out unburned hydrocarbons (HC) emissions can be reduced. But at the normal conditions, due to the NO_x emissions reduced, we can also reduce the oxygen (lean oxygen content condition) into the chamber. And the exhaust gas recirculation (EGR) system can make the exhaust gas into chamber again causing low temperature combustion, and partially load low heat loss and low blow molding losses. And, using this system, the engine can reduce the NO_x emissions during combustion. And use of this system can make the temperature low and make the fuel-air to lean for reducing the combustion reaction. And, EGR can make the part of the exhaust emission into the combustion chamber again, to make the oxygen amount to low, then make the NO_x generate small. Adverse, HC and CO emissions are increased under engine load due to incomplete combustion of the fuel during combustion and the reason that due to reduced oxygen. The fuel economy is improved according to the use of exhaust gas recirculation (EGR), and the air-fuel ratio of the chamber is diluted by this type to burn the fuel under lean conditions. On the other hand, biodiesel is one of the most suitable alternative fuels for solving these special problems. It is renewable, biodegradable,

non-toxic, very close to diesel fuel. India, Africa and other regions of the rapid growth of pollution, China's sustained economic growth slowed down, still showing demand growth. In order to respond to this demand trend of the petroleum based fuel like diesel, demand increases continuously in these countries, hence it is necessary to find the alternative solution. There are various sources of alternative energy that have been discovered like animal fats, waste food oil, non-vegetable oil, woody biofuel[3]. In the world, the demand growth of the biofuels, the different biofuels have different properties, hence we have to compare the properties of the biofuels, and there has some factors that can affect the biofuel combustion, such as air/fuel ratio, engine speed, injection timing, pressure, cetane number, viscosity, etc.

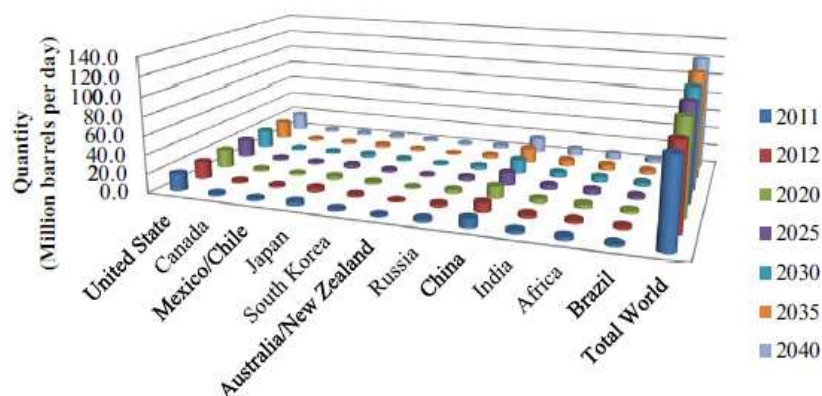


Figure 1: Production of Biodiesel in the World[3]

2. THE ANALYSIS OF ENGINE AND FUEL PROPERTIES

The different fuels/diesel blends used are: (1) Diesel (100% neat petro diesel), used as reference fuel [5]. (2) Livestock Wastewater (Raw Livestock Wastewater without any physical and chemical treatment is obtained through disposal facilities). The basic chemical constituents of the biofuel and its soluble fraction, such as nitrogen (N), phosphorus (P) and ammonia (NH₃) can be largely soluble. And, it is easy to react with oxygen [3]. These results in more unnecessary emissions of exhaust components. (3) Waste Cooking oil (diesel 60% and biodiesel 35% and triacetin 5%) [5]. (4) biodiesel (100% biodiesel rapeseed methyl ester biodiesel) [3] [5]. (5), renewable fuels, it can reduce greenhouse gas (GHG) emissions emitted by vehicles and non-road machines. It can be utilized as blending components, since the pollutant exhaust emissions [6].

In addition, biofuels contain waste food oil, animal fats, non-vegetable oils and various wood biofuels, but these fuels are not used directly in the engine combustion chamber. The important nature of these fuels in the engine takes into account density, viscosity, calorific value and cetane number etc. Because the oil cannot be used directly for the engine, ASME, EN, ISO and other different types of standards are used to define these characteristics, where, ASME is the most widely used standard.

These attributes define the engine quality and the fuel quality, on which, the emissions depend. It is very difficult to use pure vegetable oils, waste oils, waste food oils, animal oils; non-vegetable oils etc., as a fuel directly available to diesel engine, due to its higher viscosity and lower cetane number. The high viscosity can make the fuel of incomplete combustion due to high viscosity, and can cause the fuel evaporation too low and big droplet, so that is the reason which make the CO, HC, and soot emission. And the lower cetane number can cause the ignition delay, and make the combustion duration to short, then cause incomplete combustion making exhaust emission like CO, HC, high and make the NO_x reduction. Thus, the biofuel properties make an important role for engine combustion, so the biofuel properties need to be

changed in order to directly to be used, that require catalyst and transesterification reactions. The main components of animal and vegetable fats and oils are composed of triglycerides, which are esters obtained by chemical reaction of three free fatty acids and triol glycerol. During the transesterification process, the added alcohol or base material (usually methanol or ethanol or sodium hydroxide) is deprotonated with a base to make it a stronger nucleophile. It can be seen that this reaction has no other inputs than triglycerides and alcohols. Under normal conditions, the reaction will proceed very slowly or not at all, so heating and catalyst (acid and/or base) are used to accelerate the reaction. It is important to note that acids or bases are not consumed by the transesterification reaction, so they are not reactants but catalysts. Catalysts commonly used for transesterification mainly include sodium hydroxide, potassium hydroxide and sodium methoxide. Catalytic technology catalyzes the original vegetable oil to obtain our ideal biodiesel. However, most biodiesel is obtained from the original vegetable oil production using this low-cost, basic catalytic technique, because it is the most economical and practical method for treating raw vegetable oils. It requires only low temperature and low pressure, and the conversion rate is over 98% (provided the water content of the starting oil is low and free fatty acids). However, there are also biodiesel produced by other sources or other methods. Such biodiesel may also require acid catalysis or other reactions to obtain, and the process is much slower. So, the catalysts and transesterification are the process used, which converts this pure biofuels and various oils into methyl or ethyl ester or various useful fuels for engine, which through these chemical or physical methods improve properties than pure feed stocks oils. Now, the different proportions of blended fuels are widely used to improve biodiesel fuel performance.

3. EXPERIMENT ENGINE

The experimental measurements can be conducted with a fully instrumented ONE-cylinder turbocharged common rail direct fuel diesel engine with a compression ratio of 18:1. The engine specifications are listed in Table 1. And the experiment engine is used as shown in Table 1. In this experiment, sample emissions and dilution of the exhaust gases is needed, so the raw exhaust gas is diluted in a partial flow dilution tunnel. In this study, it uses a variable dilution partial flow method; therefore the dilution tunnel can be used in a full flow system [1].

Table 1: The Engine Specifications [1]

Specification	Resources
Make	Vidhata
No of cylinder	One
Bore	120mm
Stroke	139.7mm
Displacement	1580cc
Cooling	Water
Compression Ratio	18:1
Valve Timing	
Exhaust valve opening	35deg before BDC
Exhaust valve closing	4deg after TDC
Inlet valve opening	4deg before TDC
Inlet valve closing	35deg after BDC

4. THE PERFORMANCE ANALYSIS OF EXHAUST EMISSIONS

Diesel exhaust emissions consist primarily of a complex mixture of gaseous (CO, HC, NO mixed gases, etc.) and inorganic and organic components of the particles. The main component of the amount of PM fuel is composed of fine particles having a relatively high concentration in the ultrafine range. It has been demonstrated that PM consists of

agglomerates of primary carbon particles, traces of metallic ash coated with heavier organic compounds and sulfates, and nucleating particles composed of condensed hydrocarbons and sulfates, characterized by different properties. The double peaks indicate different atomic nucleation and soot [5]. PM emissions with each oxygenated blend are lower compared to the pure diesel and the reductions are greater for a higher percentage of oxygen in the blends. So, the PM emissions of oxy-fuels depend on the content of aromatic compounds and the lower soot tendency with oxygenated fuels, as generally they are free from aromatic and also are the additional factor for reducing PM. The PM emissions are shown in Figure 2.

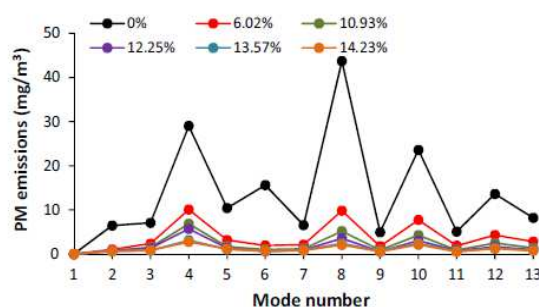


Figure 2: PM Emissions with the Pure Diesel and Oxygenated Blends [5]

From the figure 2, we can find that the oxygenated mixture has a lower PM emissions than pure diesel. Then PM emissions reductions, higher with higher oxygenated blends can be found. With the biodiesel engine, the emissions of both CO and Particulate matter (PM) are reduced when introducing biodiesel, while NO_x emissions increased.

For higher engine loads, CO emissions are higher, which is typically a feature of all internal combustion engines because, the air-fuel ratio decreases as the engine load increases.

The next discussion of PM from biodiesel combustion has a stronger mutagenic effect than petroleum diesel. In addition, increased proinflammatory response has been observed, but the oxidative potential of biodiesel PM has been reduced.

The higher percentage of oxygen in the mixture is reduced. This paper shows that the lower PM emissions of oxygen-containing fuels depend on the aromatics content of the oxygen in the fuel. Soot is a major component of PM emissions and is reduced by oxidative blends due to the presence of fuel-conducting oxygen in the local fuel-rich region. The presence of fuel-generated oxygen leads to complete combustion, resulting in a reduction in soot information. Thus, the soot of the oxygen-containing fuel tends to be low because they are usually free of aromatic compounds and may also be an additional factor in reducing the PM content of the oxygen-containing mixture.

The process of fuel NO_x formation involves the formation of various nitrogen oxides and intermediate nitrogen species. It is mainly caused by a continuous reaction (positive reaction and reverse reaction) between nitrogen compounds. NO_x will be generated by these various oxynitride during combustion. In this paper, it is studied that the biodiesel used during combustion process can be produced with excess oxygen. In order to reduce the NO_x emissions, the engine add a system that EGR let the exhaust gas into engine combustion chamber again, in order to make the temperature low and reduce the Oxygen-containing air entry chamber, causing the nitride be oxygenated. Use of this method can effectively reduce NO_x emission.

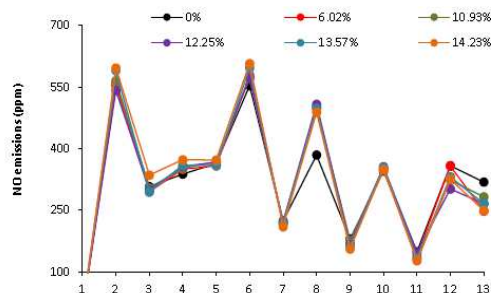


Figure 3: NO Emissions with the Reference Diesel and Oxygenated Blends [5]

Figure3 shows, NO emissions with each oxygenated blend show higher when compared to the reference diesel having 0% oxygen over the entire 13-mode range [5]. The higher NO emissions of the oxygenated mixture depend on several factors, including in-cylinder gas temperature, residence time, fuel oxygenated, fuel properties, and injection timing. It has been reported that biodiesel has higher unsaturated fatty acids than saturated fatty acids. The oxygen-containing mixture in this study can help complete the combustion, because the fuel oxygen leads to higher NO emissions from the oxygen-containing mixture. Published literature reported higher NOx emissions with oxygenated fuels. Higher nitrogen oxide emissions are also associated with advanced injection times. The higher the bulk modulus of biodiesel, the higher the viscosity and the longer the injection time, results in an increase in NOx emissions. [39]

In the production of the investigated renewable diesel, crude tall oil is used as a feedstock[13]. The NOx difference between the fuels is within the measurement accuracy range, but a slight beneficial trend can be detected in part and especially at a slight load. However, advanced high-quality CTO (crude tall oil) renewable fuels can be demonstrated and compared to almost constant nitrogen oxides, and combustion emissions from biofuels are primarily beneficial in terms of CO and HC emissions [3]. Recorded unregulated gas emissions, methane content appear to decline steadily. At major loads, the formaldehyde content is almost constant at all fuels, but at low load, the high renewable share is beneficial [2]. For half of the loads, a bimodal shape is recorded for the particle size distributions. One peak is detected at a particle diameter of app. 10nm and the other at app.35-40nm [3]. Another trend is that, the higher the renewable fuel share, the lower the maximum PN emissions. When idle, renewable fuels are significantly more favorable for PN emissions than fossil fuels. By discussion, total PN emissions decrease as the share of renewable fuels increases [5].

In the current study, the share of heat release could not be differentiated when CTO renewable diesel is compared with neat diesel. However, at higher partial loads at low speeds, HC and CO emissions decrease with increasing renewable diesel fuel, and the efficiency of the two fuels is nearly equal. Emission measurements can also be made at normal and low temperatures. A comparison at a normal temperature of 23 ° C can be concluded that the average difference in CO produced by the two fuels is very small. A similar response is detected for total hydrocarbons. Moreover, the NOx emissions are almost equal. During the test, the NOx reduction trend was observed, but even at the end of the test conversion, the average of the two fuels remained almost the same.

Different researchers have performed number of experiments to find sustainability of different biodiesel fuels as an alternative fuel for diesel engine. Under the background of the depletion of fossil fuels, researchers around the world have now conducted many experiments and studies on edible, inedible, waste cooking oils and pyrolysis oils. Strive to find renewable fuels or biofuels that can replace diesel or have the same characteristics as diesel.

Researchers Atabani et al [8] have listed a variety of non-raw materials as alternative fuels for diesel engines. These include *Pactamiapinnata*, *Azadirachta indica*, *Calophyllum illuminophyllum*, *Madhuca indica*, and so on. The use of biodiesel as a fuel has the advantage of better lubricity, availability of oxygen content and safe transport. Researchers have found that the addition of biodiesel and diesel reduces the exotherm rate and cylinder pressure, because the duration of the combustion is prolonged, so in this study, the engine uses fuel mixture with waste oil and diesel.

P. Naik et al [25] used Karanja Biodiesel as an alternative fuel to perform a performance analysis of the CI engine. Kalaniya biodiesel [18] is found to have a lower thermal efficiency than diesel. For all load conditions, it was found that the BSFC increased as the mixing ratio increased compared to the diesel fuel. Increase in NO_x emission and decrease in CO and HC emissions were found with increase in blend proportion than pure diesel fuel. And about exhaust emissions, we can observe from the figure 4 [49].

From figure 4, the report can be formed that when air–fuel lambda is over 1 than CO, HC will be reduced and conversely, the NO_x will be higher, it is because when the lambda is over 1, then air is more than fuel, and oxygen in air can make the fuel oxygenated, causing the CO and HC form CO_2 , and the NO_x be reduced.

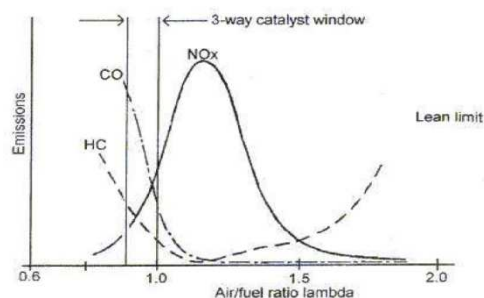


Figure 4: The Exhaust Emissions Changes [49]

And the researchers Balaji and Cheralathan [9] found that use of α -tocopherol acetate antioxidant additives and biodiesel reduce NO_x emissions, but increase HC, CO, smoke emissions and braking energy consumption. The keratin biodiesel, which is esterified and used in diesel engines, makes EGT, NO-BSEC higher and reduced HC and CO emissions.

Researchers Kasiraman et al. [27] have found a mixture of cashew nut shell oil and camphor oil, tested for the engine and a 30% mixed mixture was used to produce higher thermal efficiency and reduced emissions. Researcher, M. Srinivasa Rao et al. [15] have conducted a test to find environmentally friendly diesel alternatives. A number of experiments were conducted to determine the effect of the catalyst used for transesterification on biodiesel production. The catalyst used NaOH and KOH and oil used was pongamiapinnata. The working characteristics of biodiesel and biodiesel water emulsion were compared with neat diesel. In the performance analysis, it was found that BSFC decrease with increase in BMEP (brake mean effective pressure) for all fuels [10]. BSFC water emulsion biodiesel is higher than pure diesel and pure biodiesel. In the emission analysis, it was found that due to the presence of oxygen molecules in diesel, biodiesel HC and CO emissions are less than diesel. But in this study, Water-emulsified biodiesel exhibits more HC and CO emissions than pure biodiesel, due to the addition of fuel in the water that cause incomplete combustion in the cylinder. Therefore, due to more oxygen content and peak burning temperature, biodiesel compared with diesel, NO emissions is higher. So in this study, we can find better fuel to reduce NO_x and HC, and CO emissions are neatly engine biodiesel.

Another researcher, Atul Dhar et al. [16] states that one of the diesel emissions that adversely affect the human body and the environment is PM (Particulate Matter). Controlling diesel emissions from diesel engines is very important because, it can cause breathing problems. From the experiment, it was found that number concentration of particulates increases with increase in all engine loads. This may be due to the fact that higher fuel volumes are ejected at higher engine loads, and more fuel is burned in the diffusion combustion mode, resulting in more particles. The maximum PM emission was observed at B100[12].

And the researcher M. Mufjiur et al. [20] have reviewed the effect of biodiesel on IC engine emission reductions and concluded that, in a comprehensive situation, emissions such as CO, smoke and NO_x are less biodiesel than diesel and a lower biodiesel mixture is recommended. It is also worth noting that only about 22% of the world's GHG (greenhouse gas) emissions are from the transport sector, because the increase in demand for cars, biofuels may reduce greenhouse gas emissions by more than 80%. Through the study, it can be observed that Pongamia biofuel reduces CO smoke, and engine noise only increase in NO_x emission. And other researchers make analysis for mixing the additive to the diesel or biodiesel at different percent compared with the diesel into engine.

Researchers like How et al.[23]observed the use of bioethanol as engine performance for biodiesel mixing additives, four-cylinder, high pressure and common rail direct injection diesel engine emissions and combustion characteristics. The mixture used was B20 (20% coconut biodiesel + 80% diesel) and B20E5 (20% coconut biodiesel + 5% ethanol + 75% diesel). Comparing the mixture with diesel, it was found that B20 and B20E5 showed less smoke, CO, and NO_x emissions than pure diesel.

S. Savariraj et al. [24] have carried out studies on performance and emission analysis of fish-oil biodiesel. The blends used were B25, B50, B75 and B100. The results were compared with mineral diesel. In the performance analysis, it was found that the cooling efficiency and braking ratio of B100 were higher than that of pure diesel. In combustion analysis, it was found that peak pressure for all biodiesel blends[38] were found less than diesel start of combustion with the use of the biodiesel advanced more than 1° CA compared to diesel. The smoke density, NO_x, CO and HC emissions from all biodiesel mixtures were found. This may be due to poor biodiesel evaporation and high viscosity caused by the fish oil biodiesel fuel that is not completely burned.

5. OTHER METHODS FOR MODIFYING EMISSIONS

In the above shown researchers' performance and emission analysis, they have found that biodiesel blend up to B20 shows better thermal efficiency, lower brake specific fuel consumption, lower HC and CO emissions. Because oxygen was not enough to mix with the biodiesel, the HC and CO do not complete combustion and in this condition, the NO_x can be found less than diesel fuel. If we want to reduce the HC and CO emission, we need more air injection. But when more air is injected, only the NO_x emission observed was more due to more oxygen content and higher combustion temperature of biodiesel blend than diesel[35,38]. In other words, the biodiesel, due to the viscosity and density in the cylinder, adhere to the wall of the cylinder that can cause incomplete fuel combustion, thereby causing the increase in HC, CO and PM. Complete fuel combustion can be achieved by an addition of additive or more air injection into cylinder for burning, and such condition can cause NO_x emission increase.

The nature gas is a good fuel for engine because of its natural property. The natural gas combustion in the engine has the same limits. Compared with BSFC, refrigeration thermal efficiency, HC, CO, NO_x, PM emissions, fuel economy,

natural gas, biodiesel and diesel have a very light viscosity. In order to improve the quality of ignition and combustion, the EGR program is used to delay the ignition timing, change the fuel injector injection angle and change the geometry of the piston bowl to change the air-fuel ratio to allow the air to mix well and enter the cylinder.

The EGR program allows to reduce knocking tendency and to increase engine efficiency by increasing compression ratio. Miller cycle and EGR combination to stoichiometric conditions under the brake average effective pressure (BMEP) is increased to 1.7MPa. Under the learning combustion conditions, the use of EGR systems can improve cycle efficiency, but the combustion efficiency is affected by combustion instability and unburned mixtures in the end regions. Though EGR make fuel inside of the cylinder to be lean for combustion as shown in the Figure 5[37], it reduces the NO_x trend. And it shows that, the THC emission levels increase for lean combustion, because oxygen is not enough in the cylinder for combustion.

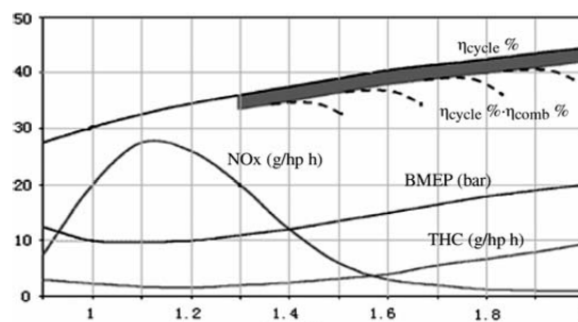


Figure 5: Effect on Nature Gas Engine Performance[37][47]

And, there is another method that changes the piston bowl geometry. This is a good method for air-fuel combustion, because in the engine, it is well known that the mixture of homogeneous lean combustion mixtures results in lower flame propagation, fire occurrence, low mixing distribution in single cylinder engines, and in the exhaust gas, high unburned HC emissions is found. Therefore, in order to reduce exhaust emissions under lean conditions, achieve maximum thermal efficiency and high compression ratios, high energy ignition systems can be used to increase eddy currents and turbulence at the end of combustion chamber compression and catalytic coatings. Another method for increasing the vortices and turbulence in the cylinder may change the geometry of the piston bowl to cause better mixing of the air-fuel during combustion, by generating eddy currents and turbulence in the bowl. Johansson et al. [48]. It was found that the piston bowl had a shape that could change the piston bowl and that the changed combustion chamber had the fastest combustion, thereby delaying the ignition timing of the MBT (maximum braking torque), as shown in Figure 6 and Figure 7.



Figure 6: Schematic of a Typical Engine Model and Piston Crown a [40]

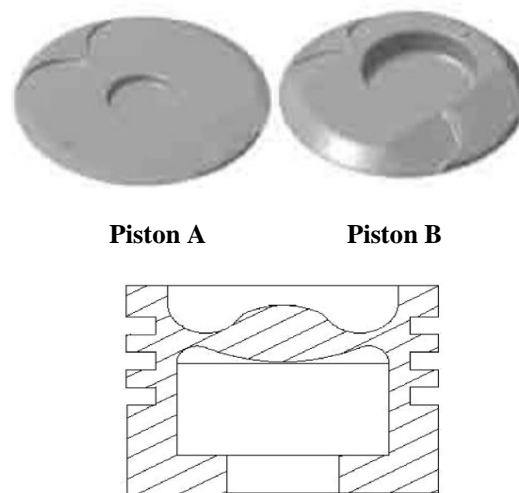


Figure 7: Combustion Chamber Geometry[39]

Other method for changing the swirl ratio in this case is, when shut-off valves are set up on the backside of the intake valves to prevent the air-fuel into cylinder through backside position of the intake valve, as shown Figure 8. In conventional engine, air can flow around all sides with non-shutoff valve through intake port into the cylinder through all directions. During the intake and compression strokes processes, in order to improve the air-fuel swirl in the cylinder, a shut-off valve is added to the backside of the intake valve, as shown in Figure 8. The air will flow only in one direction of the intake valve into the cylinder, as shown in Figure 9[40].

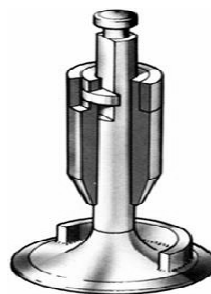


Figure 8: Conventional Valve with a Shroud

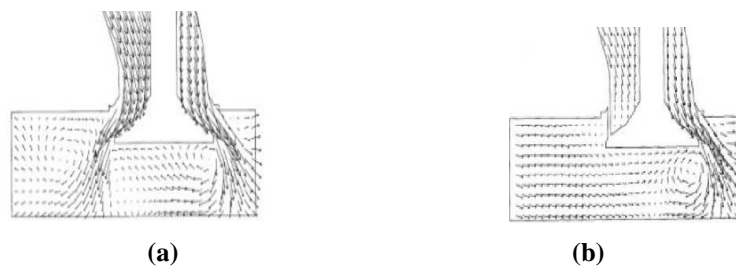


Figure 9: Show the Flow through (a) Shut-Off Valve, and (b) Non-Shut-Off Valve [40]

In an automobile running, the engine power provided by the reciprocating motion of the piston, a different crank angle can produce different air-fuel swirl. The values of air-fuel swirl ratio for the different crank angles were calculated. Similarly, the shut-off valve in the backside of the valve prevents the air-fuel flow through the backside of the intake valve into cylinder; and makes the air-fuel fluid flow through the front side into cylinder, strongly for enhancing the swirling motion; like this, in the case of one port intake, the air-fuel into the cylinder is stronger than two or multi-ports intake through the pipe. So, the results of these cases use one port or a shut-off valve that can generate higher air-fuel swirl ratio,

and improve characteristics of the exhaust emissions for vehicle engine.

6. CONCLUSIONS

This study used biodiesel as an engine fuel in the combustion process to study the effects of fuel-carrying oxygen on engine performance and exhaust emissions [5]. Therefore, due to CO and HC emissions, we can use oxygen-containing mixtures and glycerol triacetate instead of diesel fuel. Through the oxygen mixture, can reduce CO emissions, CO and HC to form carbon dioxide and carbon dioxide to reduce emissions. And use of renewable diesel; when the renewable diesel increased, CO and HC can be reduced. And NO_x will be increased due to oxygenation. But the main reason is that, the aromatic compound content is quite low, and the cetane number of the renewable fuel is higher. Oxygenated mixtures can reduce the correlation between PM and soot, but through testing, we can see that biodiesel fuel emissions are generally consistent with previously reported data in the literature, and compared with standard petroleum diesel, carbon monoxide and Low NO_x emissions increase. The question is, how to reduce NO_x emissions? To reduce the NO_x emissions, we can use renewable diesel (Fischer-Tropsch diesel) that can replace fossil diesel fuels. When produced from biomass, the fuel produced can be simply referred to as biomass-liquid or BTL fuel. The feedstock is natural gas product called GTL (Gas-to-liquid). This fuel, on investigations revealed lower NO_x emissions of GTL fuel than neat diesel. So, the GTL fuels blends showed higher NO_x emissions decrease [3].

The fuel injection timing is detrimental by the engine, because the NO emissions of diesel and biodiesel engines are at specified loads and speed due to the combustion of more fuel in the premixed combustion stage, due to the increased delay. The mixture burns up to a higher temperature and increases significantly. In other words, the delay in injection time results in a reduction in NO emissions of fuel.

Lean combustion is a method that can effectively improve fuel combustion efficiency and reduce NO_x emissions. Through EGR system, can reduce the NO_x emissions. Due to EGR system, the exhaust again moves into the cylinder causing the mixture to be lean and the air is not enough for combustion, so NO_x emission reduced but the HC and CO increased in the EGR system. In the combustion chambers, lean combustion limits are dependent on combustion chamber geometry, ignition timing, ignition energy and turbulence. In order to improve the air –fuel mixture ratio, we change the bowl geometry shape.

Other methods are to increase the fuel combustion effectiveness of the engine by varying the number of ports and adding a shut-off valve to account for increasing the vortex ratio of the air-fuel mixture. Results can be obtained using the shut-off valve in the cylinder, can get higher swirl ratio greater than having a non-shutoff valve and improved characteristics of exhaust emissions for vehicle engine.

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